

High-Pressure Phase Behavior of Binary Systems of Carbon Dioxide or Trifluoromethane and Certain Ionic Liquids

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Ionic liquids are organic salts composed of cations and anions, which usually are liquids at room temperature. The following physical properties of ionic liquids make them interesting as the next generation of solvents for industrial applications:

- Good solvents for a wide range of substances: organic, inorganic, polar and non-polar;
- Ionic liquids have negligible vapor pressures, which reduces solvent emission to the environment;
- They have suitable densities and viscosities.

Therefore, they may replace toxic, flammable, and polluting volatile organic solvents, such as toluene, hexane, and dichloromethane.

Besides the advantages mentioned above, ionic liquids based on the methyl-imidazolium cation are attractive species, in particular because of their air and water stability, and their wide liquidus range.

Most of the work in this area has been focused on synthesizing methods of ionic liquids or the application of ionic liquids as solvents in catalytic reactions. Although the study of solute recovery from ionic liquids, using supercritical fluids is a potential field of applications, a systematic study on this is lacking. Therefore, knowledge of the phase behavior of near-critical fluids + ionic liquids is of major interest.

In this work, the high-pressure phase behavior of binary mixtures of CO₂ or CHF₃ with the ionic liquids 1-alkyl-3-methylimidazolium hexafluorophosphate, with as the alkyl group ethyl, butyl, hexyl, and octyl, i.e., ([emim][PF₆]), ([bmim][PF₆]), ([hmim][PF₆]), and ([omim][PF₆]), has been studied experimentally. Pressures up to 100 MPa have been applied. The effect of the different alkyl groups on the solubility of CO₂ and CHF₃ in the various ionic liquids has been analyzed. It has been found that the fluid phase behavior of the binary systems with CO₂ is different compared to that of the binary systems with CHF₃. For instance, the experimental work suggests that the ionic liquids do have a measurable solubility in the gaseous CHF₃ phase, which is not the case in the gaseous CO₂ phase.